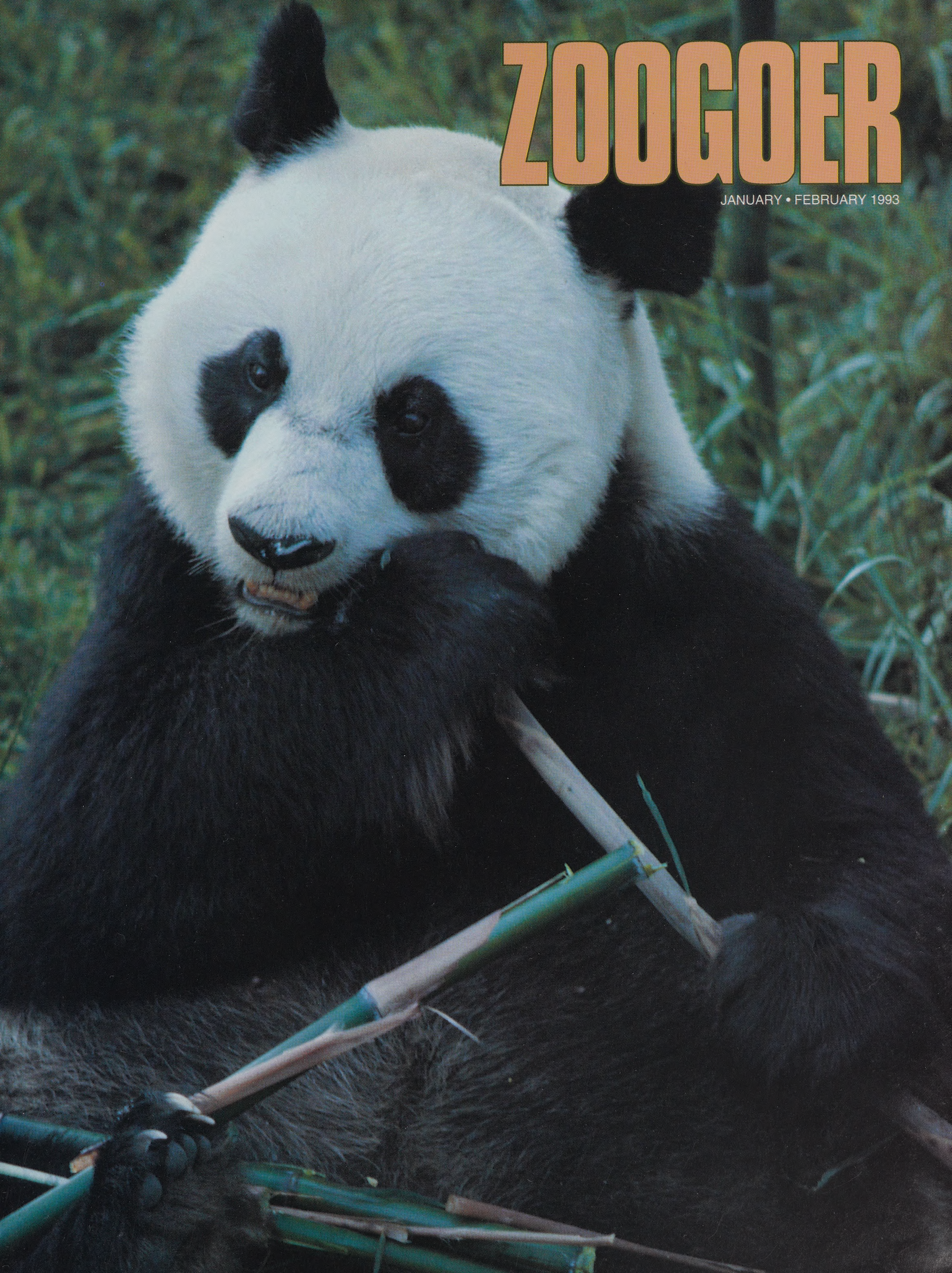


ZOOGOER

JANUARY • FEBRUARY 1993



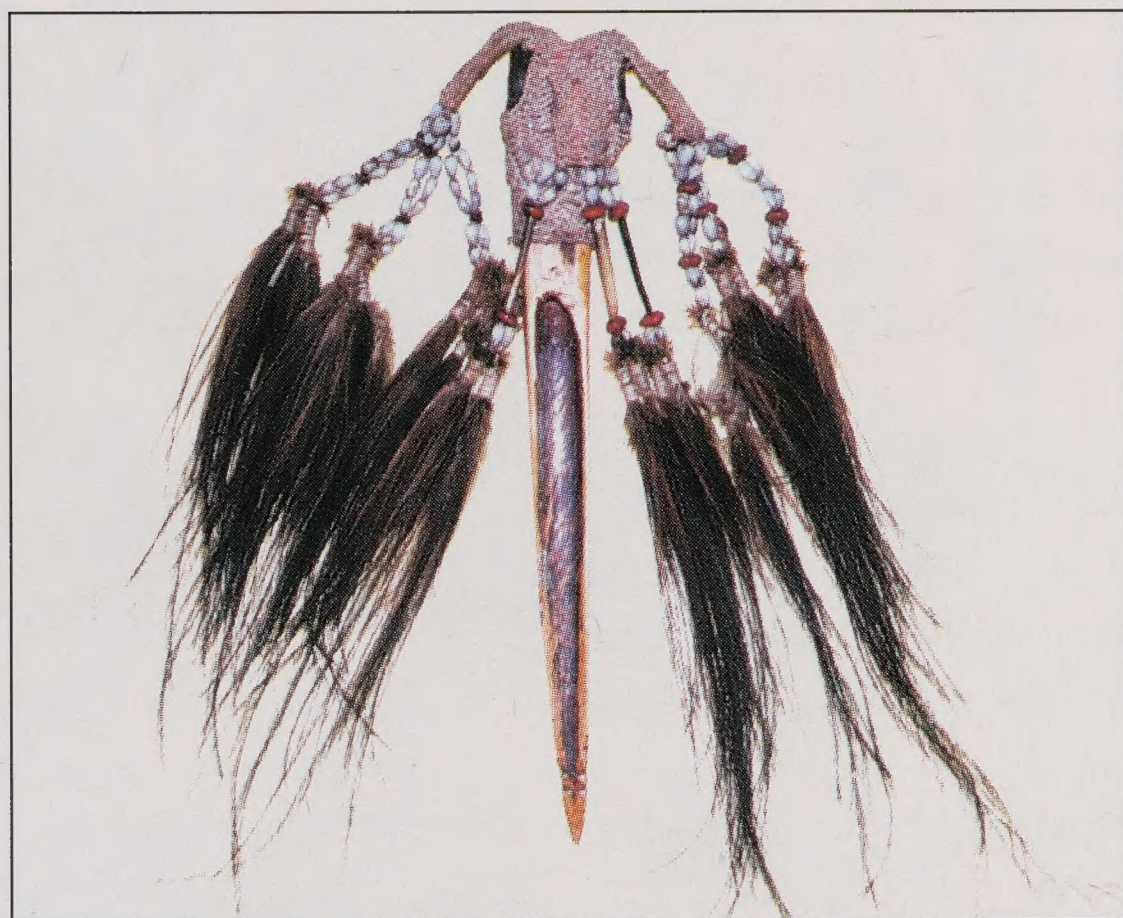


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Ceremonial dagger fashioned from the legbone of a cassowary. Private collection. (John Seidensticker)

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Mary K. Miller

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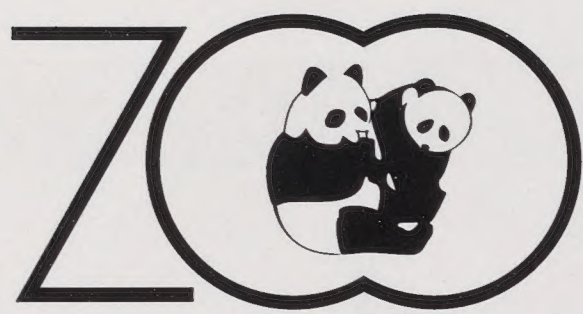
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of the
National**



is a nonprofit organization of individuals, families, and organizations who are interested in helping to maintain the status of the National Zoological Park as one of the world's great zoos, to foster its use for education, research, and recreation, to increase and improve its facilities and collections, and to advance the welfare of its animals.

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Cover: Ling-Ling, the Zoo's 23-year-old female giant panda, died December 30, 1992. (Jessie Cohen/NZP Graphics)

Ling-Ling

I don't need to report here that Ling-Ling has died. Anyone who isn't stranded on a desert isle without a radio has heard the news of the death at age 23 of the National Zoo's female giant panda. But I do want to reflect a little on the meaning of Ling-Ling, her transcendent significance.

When Ling-Ling died she was the oldest giant panda outside of China and had lived far longer than giant pandas are believed to live in the wild. Here at the Zoo, we were prepared for Ling-Ling (or Hsing-Hsing) to die; its imminent possibility was much discussed. But still, news of her death was first met with shock, even disbelief. It was more like our response to the sudden death of a healthy child than to our very different response to the quiet passing of an octogenarian.

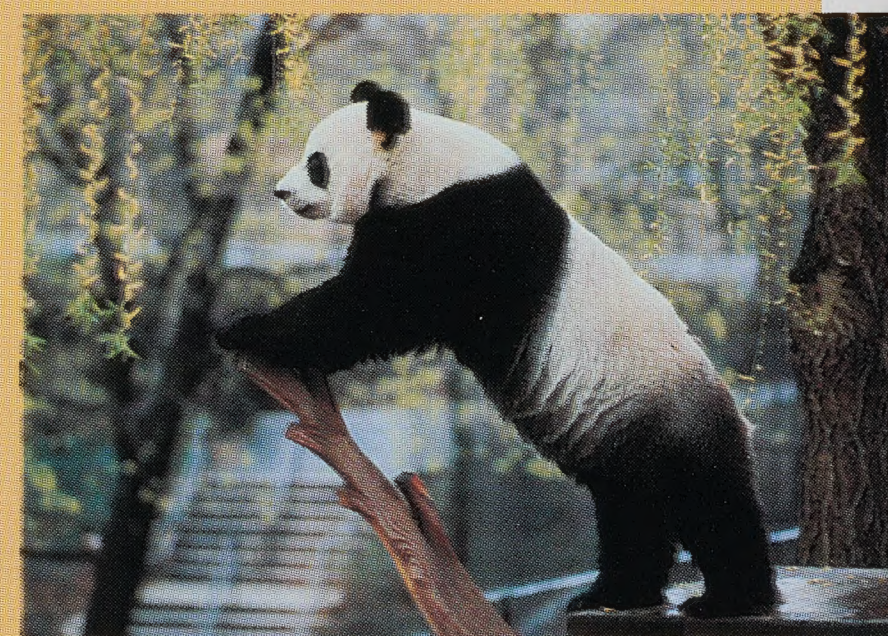
I thought about this as I watched the news spread with lightning speed across the country and around the world, and people began calling and writing to express sadness and sympathy. Ling-Ling was eulogized in print and on the air. Even now, a week later as I write this, Ling-Ling's life, death, and "afterlife" are being widely recounted, treatment accorded only a small number of people, and perhaps only one or two other animals, ever.

One cynic gave Ling-Ling the epithet "tourist attraction." Yes, but only in the sense that the White House is a tourist attraction. Another writer's "cultural icon" is a more accurate description, one, for instance, also applied to Rudolf Nureyev when he died a week after Ling. Just as Nureyev came to mean, to embody, to personalize and popularize ballet, so Ling-Ling came to embody endangered wildlife. She personalized and publicized the idea of wildlife conservation. And I think that it is the death of the symbol that creates such shock even among those prepared for the death of an old, well-loved bear.

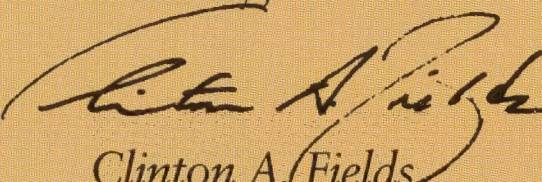
Some might shudder at the anthropomorphic oxymoron of an animal *personalizing*. Indeed, Ling-Ling was an animal, oblivious to her celebrity and indifferent to the attention and concern of her millions of fans. But as a "personality," Ling-Ling awakened more people to the plight of endangered species and habitats than any number of appeals on behalf of nameless, faceless species, even charismatic "flagship" species such as tigers and gorillas. This is human nature—we respond to individuals we know (or feel like we know), not to abstract others.

Twenty years ago, when Ling-Ling and Hsing-Hsing came to the Zoo, no press account we can find even mentioned the words endangered or conservation in reporting the story. Today, no press account does not. And, every schoolchild knows these words and something about the animals they apply to. It would be overstating the matter to say that Ling-Ling and Hsing-Hsing are responsible for this, but surely they helped.

Ling-Ling proved unable to contribute to the survival of giant pandas through reproduction. But she leaves a perhaps more important legacy: millions of people who care about the survival of all species.



Sincerely,


Clinton A. Fields

Executive Director

An underwater photograph of a coral reef. A diver is visible on the left side, swimming towards the right. The reef is covered in various types of coral, including branching and table corals. The water is clear and blue. The title "Life and Death on the Coral Reef" is overlaid on the top half of the image in a large, orange, serif font. A small red starburst graphic is located near the end of the word "Reef".

Life and Death on the Coral Reef

Mary K. Miller
Photos by Daniel Haut

"A long list of the Latin names of the corals of a reef... conveys no impression even to many zoologists of the infinite variations of form, structure and colour which those corals actually present in the living state. A coral reef cannot be properly described. It must be seen to be thoroughly appreciated."

—English zoologist Sidney Hickson, 1889

I plunged backwards from a flat-bottomed dive boat into the Caribbean, full of expectation. This was my first time diving a tropical coral reef, one of the richest and most threatened of marine habitats. As soon as my back slapped the warm turquoise sea, I flipped over to take in this new world. Barely visible as a distant shadow 80 feet below was the top of Palancar, the largest coral reef of Cozumel Island, which lies off Mexico's Yucatan Peninsula.

I was disappointed at first—the tropical sea appeared empty. No majestic kelp forest rose from the depths, as I'd seen in my native diving grounds of Monterey Bay, California. Instead, there was just seamless crystal-clear water, expanding into a mid-night-blue horizon. For a moment though, I

reveled in the feeling of 85-degree water caressing my bare limbs before kicking down for a closer look at Palancar.

Palancar reef is a coral-built fortress stretching for two miles off the southern tip of Cozumel, its rock base plunging 1,300 feet to the ocean floor. From a distance, the massive structure built by tiny animal architects looks like a castle, with crenelated turrets and honeycomb passageways threading through vast hallways of sand. The cornerstone of this castle was laid some 9,000 years ago.

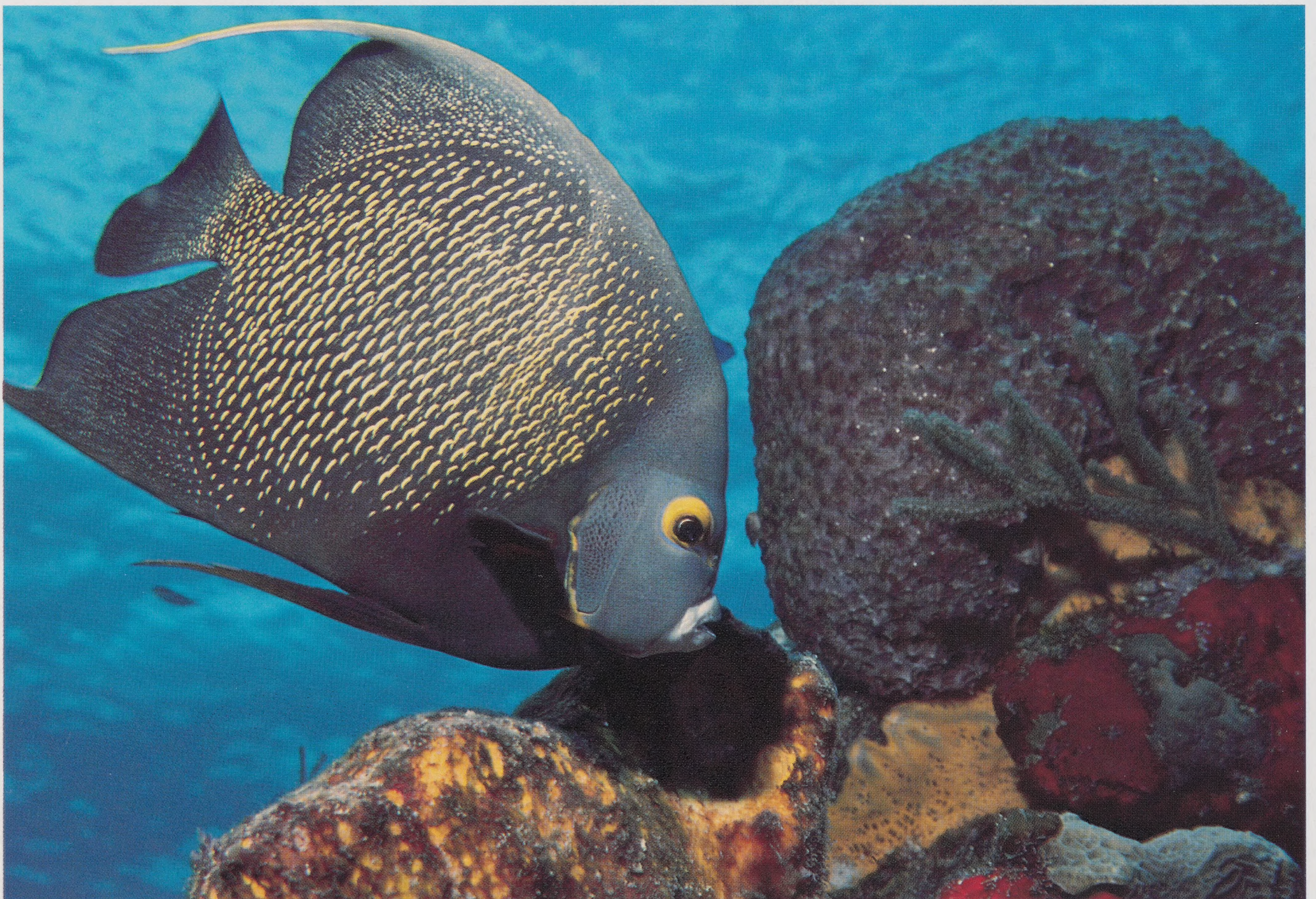
The reef began with a microscopic, peanut-shaped larva, the free-floating youngster of a sedentary adult coral. Related to sea anemones and jellyfish, corals share the habits and lifestyles of both of these invertebrates. In its planktonic stage, the coral larva drifts on the ocean currents like a jellyfish. As an adult, it resembles its closest relative, the sea anemone, sharing a similar rock-bound existence. Like all cnidarians (including jellyfish and anemones), corals have specialized stinging cells called nematocysts. Densely packed into the six or more tentacles that surround

the coral's mouth, the nematocysts deliver tiny poison darts to paralyze small prey that drift within reach.

Not yet equipped, however, with the nematocyst-barbed tentacles of an adult, the larva grabs whatever food floats its way. After surviving for months on the open sea, where millions of kin were gobbled up by fish or forced by currents into the deadly cold polar waters, the far-ranging coral larva frantically beats the tiny bristles that surround its body and heads for a rocky outcropping, possibly in response to chemical signals from the substrate. Once there, it latches onto its permanent foundation and settles into a new life. Never to wander again, the larva transforms into its adult polyp form and begins building a cup-shaped limestone skeleton around itself.

A Self-contained Food Web

The young coral, however, is not yet home free. The key to its future success lies in recruiting hundreds of tiny partners: single-celled, symbiotic algae called zooxanthellae. The zooxanthellae take up residence in the



French angelfish on Palancar. These shy, elegant fish are usually seen either alone or in pairs.



Anemone, with schools of fish on Palancar. Many fish form associations with anemones, feeding off discarded scraps and parasites.

coral's soft tissue and, through photosynthesis, begin converting energy from the sun into food for both themselves and their host. The coral contributes to the joint venture by exposing its algae-studded body tissue like a green carpet to catch sunlight during the day. Zooxanthellae absorb carbon dioxide and other waste products used for photosynthesis directly from the coral's tissue. In turn, the algae produce oxygen, carbohydrates, and other organic compounds that nourish the coral.

This efficient cycling of energy and nutrients between plant and animal is essential to the productivity of the entire coral reef. Without zooxanthellae, individual corals can still survive by capturing tiny crustaceans and other drifting plankton with their stinging tentacles. But the polyp's ability to deposit its reef-building limestone skeleton, and to grow, reproduce, and form a large colony is crippled without the help of the symbiotic plants.

Together, animal and plant form a complex organism that is its own small, highly productive food web. Together, they act as a primary producer by photosynthetically converting sunlight into food; as an herbivore, by consuming products of photosynthesis; and, as a carnivore, by capturing plankton with stinging tentacles. By sharing resources and working together, the coral-algae partners are stronger and more resilient to changes in the environment and food supply.

Securely attached to the rock and now with a thriving algae garden churning out food, the coral polyp starts reproducing, making exact copies of itself by budding. (Reef-building corals also reproduce sexually, when they mature at between three and eight years of age. In most species, the corals in a colony synchronously release sperm and eggs during a brief annual breeding season. Fertilized eggs become the free-swimming larvae that eventually settle on new rock surfaces.) One polyp is soon two,

those two make four, then eight, and so on, slowly spreading across the bare rock until it's jammed with polyp blossoms nestled in their tiny cup-homes.

Some individuals in long-lived coral species can survive for up to 140 years; most reef-building corals, however, have a lifespan of one to three years. As the older polyps die, new clones grow on top of their empty skeletons and, layer by layer, inch by inch, the colony rises toward the ocean surface. (Under ideal conditions, colonies can grow upward at a rate of two to three inches a year.) Millions upon millions of individual coral polyps, descendants of the original settlers, stack their skeletons one atop the other, gradually building a reef like Palancar into the huge fortress it is today.

Other invertebrates, fishes, and plants are attracted to the shelter and teeming abundance of the coral reef habitat. As I swam through Palancar that day, I saw schools of silvery blue tang, shyly receding into the coral channels; elegant angelfish, with their striking midnight-blue and fluorescent-yellow scales; clouds of neon-pink fairy basslets; and a single prickly balloonfish that, upon my approach, pumped itself up to resemble a chunky pincushion. Lurking under coral archways were schools of predatory blue-striped grunts.

Rainforests of the Sea

In a dizzying confusion of color and motion, a thriving coral reef like Palancar is



Palancar reef is a coral-built fortress stretching for two miles off the southern tip of Cozumel, its rock base plunging 1,300 feet to the ocean floor. From a distance, the massive structure built by tiny animal architects looks like a castle, with crenelated turrets and honeycomb passageways threading through vast hallways of sand.



The squirrelfish is a member of an ancient order of fishes that ruled the reef while dinosaurs ruled the land.

one of the ocean's richest habitats. All manner of living things, from single-celled bacteria to large and menacing sharks, make their living on the reef. The competition among organisms for food and space on the reef is intense, leading to an incredible array of survival and feeding strategies.

Animals dominate the visual landscape of reefs like Palancar, but plants actually make up 75 percent of the reef's biomass. These plants include dense mats of very fine, fila-

mentous algae, larger seaweeds, and encrusting coralline algae. (Like animal corals, coralline algae secrete limestone deposits to form a virtually impenetrable protective armor.) Hundreds of species of grazing fish and invertebrates depend on this verdant reef garden for their sustenance.

Species belonging to every major group of marine invertebrate can be found on the reef. Reef-associated invertebrates include sponges, cnidarians (this group includes two major types of coral: stony corals, the symbiotic reef-builders, and soft corals, branching colonial forms that have no symbiotic algae), marine worms, mollusks (snails, clams, and mussels), bryozoans (microscopic organisms that form upright feathery or encrusting lacy colonies), echinoderms (sea stars and urchins), and chordates (the closest invertebrate relatives of backboneed animals, this group includes sea squirts and tunicates).

Many invertebrates, including the corals themselves, appear only after twilight descends on the reef. Returning to Palancar for a night dive, I saw a world transformed. Safe from the sharp teeth of the diurnal

fishes that graze on tender polyps, the corals emerge from the protection of their limestone homes, extending delicate tentacles into the dark water to feed. During the day, the reef architecture is dominated by sharp edges and rocky outcroppings; at night its surface becomes a soft, fuzzy blanket of waving tentacles.

As I swam across a reeftop illuminated by my dive light, I saw some of Palancar's other night creatures. Sensing my presence, a double-plumed Christmas tree worm snapped back into its tube like a reverse jack-in-the-box. To dig its tunnel in the coral reef, the worm secretes an acid that dissolves the hard limestone. Brittle stars skim lightly across the reef powered by long, bristle-covered arms. Graceful nudibranchs, which are snails without shells, swirl and twist their way through the water. These delicate, spectacularly beautiful animals would be ripped apart by predators if they appeared during the day; at night the nudibranchs roam the reef in relative safety.

Despite the beauty of an occasional nudibranch, it is really the fish that steal the show on a coral reef. Flamboyant and abun-



A Christmas tree worm and sponges.

dant, these vertebrates are the most conspicuous reef inhabitants. In both biomass and diversity, a healthy coral reef has more fish than any other marine habitat.

The fish are also diverse in lifestyle: Individual species fill virtually every feeding niche on the reef. Various fish dine on microscopic algae and bacteria, invertebrates, coral mucus and coral polyps, and even on other fish species. Most reef-associated fish are very selective in their diets. Certain butterfly fish eat nothing but the living polyps of one particular coral species; others dine on nothing but sponges; still others, sporting jaws that look like needle-nosed pliers, reach deep into cracks for hidden invertebrates. Trigger fish use powerful beaks and specialized predatory techniques to feed on heavily armored sea urchins.

One of the most unusual feeding niches on the reef belongs to the wrasses—small, brightly banded fishes that set up “cleaning stations” for larger fishes. As a potential customer enters a wrasse’s territory, the cleaner fish darts up and down the visitor’s body, picking off any parasites and loose scales it finds. The wrasses even enter the open mouths and gill cavities of predators, such as groupers, that could easily swallow them whole. That the wrasses go about their work with impunity attests to the valuable service they perform; with no means to groom themselves, the larger fishes depend on the cleaners to remove troublesome parasites.

With its incredible assemblage of plants and animals, a thriving coral reef like



Patterns of bleaching in an otherwise healthy coral colony.

Palancar rivals terrestrial tropical rainforests in biomass and diversity. But, like rainforests, these undersea habitats are vulnerable to human activity.

Diversity Under Siege

Twenty years ago, for instance, Palancar supported a thriving forest of black coral, which is not actually a true coral but related to sea fans. The glittering, black, 10-foot-high trees, made of hundreds of thousands of individual polyps, were plun-

dered to make jewelry for tourists. Walking through Cozumel village, I saw dozens of shops selling spiky black coral necklaces and earrings, but I found no living black coral on my underwater forays.

At one time, schools of giant sea bass and huge groupers swam among Palancar’s tunnels and turrets. Divers, armed with sharp spears, hunt the ponderous, slow-moving fish to feed tourists on the thriving island resort. In a week of diving off Cozumel, I saw only one giant grouper.

For the continued survival of tropical coral reefs, tourism is a double-edged sword. The income from a lucrative tourist trade encourages governments to preserve the habitats that visitors come to see and enjoy. But the very presence of thousands of tourists, who must be housed, fed, and entertained, puts pressure on the underwater habitats (not to mention above-ground ecosystems).

For corals and their resident algae to thrive, the water must be clear, which is why reefs do not form where rivers dump sediments into the sea. Construction of resort hotels near reefs in the Caribbean and other tropical seas stirs up mud and silt, clouding the crystal water. The day-to-day operations of the hotels spew out effluents that poison and choke the corals.

To make room for new resorts and businesses, coral reefs are often “reclaimed,” which means either blown up or buried under sediment to make an artificial island. In



A thriving coral reef like Palancar is one of the ocean’s richest habitats. All manner of living things, from single-celled bacteria to large and menacing sharks, make their living on the reef. The competition among organisms for food and space on the reef is intense, leading to an incredible array of survival and feeding strategies.



Sunset on Cozumel.

the tropics, coral rubble, the broken pieces of a limestone reef, is a cheaper building material than cement. Dynamiting a live reef provides a steady supply of coral rubble for emerging construction industries. This practice not only destroys the top layer of living coral, it also wipes out the reef-dependent organisms and topples the local fishing trade, an important source of food for many tropical nations.

Other human activities also threaten the survival of thousands upon thousands of

the world's coral kingdoms. Dynamite fishing, coral collecting, shell collecting, and the aquarium fish trade all do damage to coral communities. Aquarium fish collecting is especially shameful. Hunters squirt cyanide from plastic bottles to stun their prey, but they kill nine fish for every live one they capture and they poison corals and other animals and plants on the reef. Although the practice has been outlawed, many divers still use cyanide to collect fish.

There are natural threats to tropical coral reefs as well. An explosion of spiny urchins off Kenya's coast has eaten away vast stretches of living coral polyps faster than they can recover. In Australia's Great Barrier Reef, and in the innumerable reefs of South Pacific islands, the crown-of-thorns sea star, a science fiction creature with poison spines and 20 arms, has moved through en masse and destroyed acres of living reef at a time. The devastated coral colonies may need six to eight years to recover after such an attack. (Some scientists believe that human collecting of giant triton snails, one of the few sea animals known to feed on adult crown-of-

thorns sea stars, has allowed this archenemy of corals to multiply out of control.)

Given time, the industrious coral can repair the damage wrought by nature and humans. But, a truly frightening new threat, one with global implications, is the warming of tropical oceans. Brought on by the buildup of greenhouse gases in the 1980s and 90s, this warming trend has produced cycles of massive "coral bleaching" in the Caribbean, off the coast of south Florida, in the Great Barrier and other reefs off Australia, and 15 other sites throughout the Pacific and Indian oceans.

Most tropical corals live close to the upper limit of their temperature range, between 65 and 85 degrees Fahrenheit. When the ocean warms above 85 degrees, as it did in 1979-80, 1982-83, and 1986-87, the coral responds first by expelling its gardens of zooxanthellae in thick yellow-brown clouds. Corals can still find nourishment by straining the ocean for plankton, but without their resident algae the ghostly white corals are weakened and vulnerable to disease; not all survive. Because corals may take many years to regain their original vi-



Corals fully open. Pumped full of water and expanded to feed, these coral polyps will retract into their skeletons at sunrise.

tality, new bleaching cycles may strike before the corals have recovered. The further damage caused by pollution, overfishing, and direct physical destruction may reduce the natural ability of coral reefs to withstand these temperature changes.

The Resiliency of the Reefs

What took the corals thousands of years to build could be destroyed in a single generation by humans. It's not yet time, however, to draw the curtains on coral reefs. Many tropical biologists believe that corals are far hardier than they've been given credit for and will endure this spate of warming cycles.

A good example of the coral's ability to survive under adverse conditions can be found in the Persian Gulf. Subjected to yearly oil seepage of a million gallons or more from the oil-producing countries ringing the gulf, these waters nevertheless support a healthy population of stony corals and a thriving fishing industry. (During the recent Gulf War, millions of gallons of oil flooded into the Persian Gulf, causing an uproar in the international environmental community. On a 1991 cruise to survey the damage, biologists were surprised to find only minimal coral death from the massive spill.)

The gulf corals must also contend with extreme swings in water temperature, from winter lows in the 50s to scorching summer highs in the 100s. The corals do not always survive these temperature fluctuations: in February 1989, a bleached reef was discov-



Brittle stars emerge from the protection of a vase sponge to find dinner on the night reef.

ered off the coast of Saudi Arabia. Researchers surmised, however, that it was not the high temperatures that killed the coral. Instead, an unusually cold winter coupled with low tides left the corals exposed and unable to protect themselves against the freezing temperatures.

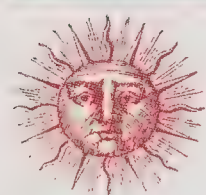
Corals have lived in the Persian Gulf for only about 15,000 years—before that the channel was dry land. Somehow, in this short evolutionary time span, these remarkable animals have adapted to intense environmental pressures. The pressures do take

their toll; the gulf reefs are not nearly as diverse and beautiful as those in the nearby Red Sea, but they generally hold their own from year to year. Perhaps coral populations in other parts of the world have the same hidden reserves to fight back against a harsh environment.

Scientists are now taking an active role in shoring up coral defenses and assisting in nature's healing processes. Scientists at the Smithsonian Tropical Research Institute in Panama are experimenting with a technique to recolonize bleached, dead reefs with living coral polyps. Just 18 months after work on a reef in Costa Rica, transplanted coral fragments have bloomed into colonies big enough for likely survival. Scientists hope that eventually these reseeded areas will support the same complex, interconnected ecosystems as an undisturbed reef.

These efforts take time and money, however. With no one country claiming ownership or responsibility for most ocean habitats, there are few incentives to conserve, rather than exploit, the underwater kingdoms. Humans are only occasional visitors beneath the turquoise seas and most people never come face to face with the beauty and majesty of a tropical coral reef. Because it is easier to ignore what we do not see and touch, these ecosystems remain vulnerable to destruction. ♣

Former ZooGoer Assistant Editor Mary K. Miller is now a science writer based in the San Francisco area.



What took the corals thousands of years to build could be destroyed in a single generation by humans. It's not yet time, however, to draw the curtains on coral reefs. Many tropical biologists believe that corals are far hardier than they've been given credit for and will endure this spate of warming cycles.



Tamarin TAXONOMY.

In 1840, when Brazil's Atlantic coastal rainforest was still intact, two renowned naturalists far from the beaches of Rio de Janeiro busily sorted out the taxonomy of Brazilian monkeys. The early and middle decades of the 19th century were exuberant years in the halls of zoology, as specimens of animals, many new to science, flowed to Europe from all over the globe. In France, Rene-Primeverre Lesson, and in Germany, Johann Andres Wagner, published updated classifications of mammals. They included revised taxonomies of the lion tamarins. These were the first works to propose that the three lion tamarins then known—two discovered only 20 years before—should be classified in a special genus.

Each zoologist created a new taxonomic name to symbolize the separation of lion tamarins from unrelated species. Lesson selected *Leontopithecus*; Wagner chose *Leontocebus*. Was it an odd coincidence that two scientists should pick such similar names for the same animals? And how are we to select which label should stand and which should fall? And why should anyone care?

I first became interested in the arcane world of zoological nomenclature somewhere along the road to my Ph.D. Busywork was what I was after, a respite not too far afield from my real goal, which was to revamp the sys-

Alfred L. Rosenberger

Illustrations by
Stephen Nash,
Conservation International

Lesson Behind the Names



Golden lion tamarin *L. rosalia*

tematics—the phylogeny, adaptations, and classification—of the New World monkeys. I seemed always to be measuring tiny marmoset teeth or grapefruit-sized howler monkey skulls, or mapping the spidery web of grooves left by arteries that once pulsed inside the head of a capuchin monkey. Rummaging through dusty libraries of great natural history museums was a perfect excuse to leave my calipers and notebook behind for a while.

Browsing through old literature was fun. It was filled with splendid, posterlike artwork, meticulous color portraits that zoologists published along with their technical descriptions of new species. It revealed what my predecessors knew and imagined about animals, and how they operated as scientists. And, the old books and pamphlets were bursting with names, many forgotten generations ago. These were codewords to an ancient store of information, exotic compounds created by the authors themselves from Latin or Greek or some delicious native tongue.

There were many more names than species or genera, for names had been accumulating through miscommunication, typographical error, and science as well. There were names that, in taxonomic jargon, had been *sunk*, *replaced*, *synonymized*, and *suppressed*—meaning mothballed—for one technical reason or another. Some of them held a special fascination, for they seemed to have a destiny of their own.

Although left behind, buried by the weight of time and a flourishing literature, they were dressed and ready to go. Someday they would be returned to enjoy another useful life in the vocabulary of science.

There was also a boldness and power in all those taxonomic names. They were and are the dueling instru-

ments of competing researchers, whose battles are fought always in the public forum of the scientific literature. To *erect* a taxonomic name is to loft a scientific idea. To *sink* it is to claim the theory is wrong.

Moreover, that power has a unique dimension because force is retroactive. Unlike historians, who try not to tamper with the past, taxonomists often have to rebuild it. Names that were left undefined frequently need to be re-specified or modified if the system is to work. A name entering the lexicon in the 1800s may have little meaning for 100 years until it is revived, possibly to serve in a new context. Given the interconnectedness of zoological names, this sometimes unleashes a cascade of change.

A Pair of Common-sense Proposals

I was drawn to the fascinating coincidence of Lesson and Wagner in 1978, when I began to see that changes in the then current structure of lion tamarin taxonomy were necessary. For decades these monkeys were seen as a single species, but one dissenting voice, Otavio Della Serra, claimed in 1951 that there were at least two. I was not in full agreement, but the prospect of taxonomic reform meant that nomenclatural revisions were likely.

Leontopithecus and *Leontocebus*—two names so alike given by two different authors for the same animals in the same year. My guess is that Lesson and Wagner were employing good common sense and trying to solidify a terminology that had gotten away from itself.

Linnaeus, the father of modern taxonomy, first introduced the formal name for the golden lion tamarin in 1766, as the genus and species combination *Simia rosalia*. This was a simple allusion to the primate's reddish-gold fur, a reminder that coloration was a major identifying characteristic of the species. However,



Black lion tamarin *L. chrysopygus*

the common names of the period also aptly described the animal's appearance. Terms like "lion monkey," "little lion monkey," and "silky monkey" were all fairly clear references to the "GLT," which is the current nickname for *rosalia*. Working in the earliest days of modern taxonomy, Linnaeus had also dubbed other nonhuman primates with the genus name *Simia*. So, a careless, elliptical reading of his *Simia rosalia* could be mistaken for a number of things, including the red ape—the orangutan, or the uakari, the elusive red monkey of the Amazon.

Almost 50 years after Linnaeus gave the species name *rosalia*, two more eastern Brazilian tamarins were described by different authors. Neither was reddish-gold but each wore that distinctive leonine mane.

Later still, in their fateful year of 1840, Lesson and Wagner realized that these new species should be grouped with Linnaeus's *rosalia* in a genus all their own. In proposing their generic names—*Leontopithecus* and *Leontocebus*—they showed the similarity of all three forms with an umbrella term that was familiar and descriptive, too. Independently, they revived the old convenient metaphor in using the Greek and Latin word for lion, *leon*, as a basis.

Both zoologists also selected similar nouns to complete their names: *cebus* and *pithecus* are Greek for monkey and ape, respectively. This, too, reflected tradition. There are about 10 living primates, and many more extinct ones, whose generic names end in precisely the same way, not counting the capuchin monkeys of South and Central America, which are simply *Cebus*. The genus and species names of Lesson and Wagner

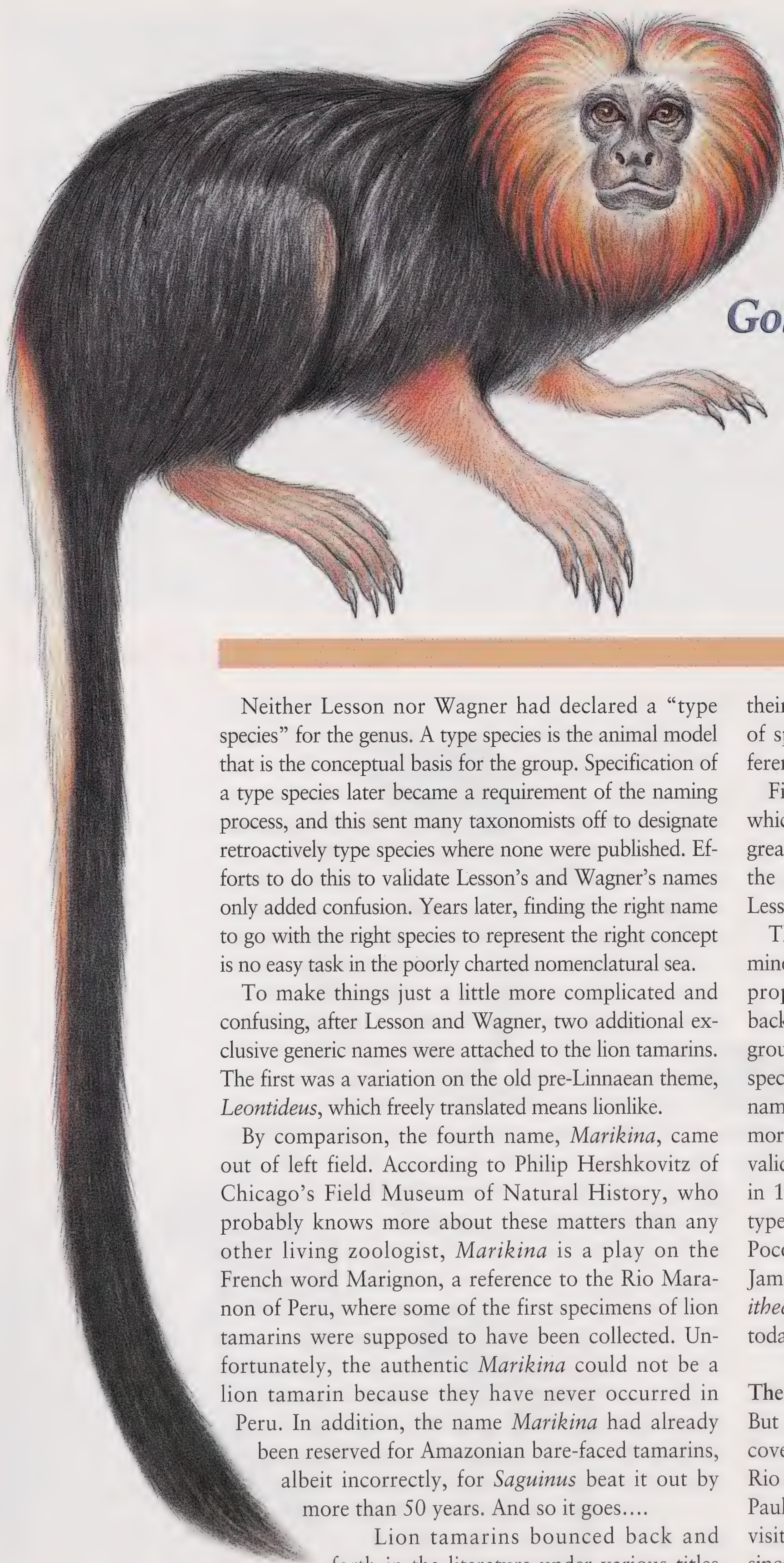
merely echoed the first zoologically based name given to the animal when it was described 84 years before the Linnaean system was put into practice—*le petit singe-lion* (the little lion monkey).

Which Should Stand?

Lesson and Wagner unwittingly left the legacy of twin names delivered the same year. Which one should remain? In the field of nomenclature, priority is nine-tenths of the law; the excruciatingly complex naming rules by which zoologists try to abide are confined to the other tenth. So, because neither Lesson nor Wagner was first, scientists had to turn to the arcane tenth.

From a Mammalian Species account by Devra Kleiman, published in May 1981 by the American Society of Mammalogists.

Leontopithecus Lesson, 1840
Leontopithecus Lesson, 1840:184, 200. Type species designated by Pocock, 1917:255, as *Leontopithecus marikina* Lesson.
Marikina Gray (not Lesson), 1843:xviii, 15. Type species by tautonomy *Leontopithecus marikina* Lesson.
Leontocebus Elliot (part, not Wagner, 1840 = *Saguinus Hoffmannsegg*, 1807), 1913, 1:xxxv, 194. Type species designated as *Hapale chrysomelas* Wied (but Miller, 1912:380 had already designated *Midas leoninus* E. Geoffroy = *Saguinus fuscicollis* Lesson as type of *Leontocebus* Wagner).
Leontideus Cabrera, 1956:52. Renaming of *Leontocebus* Elliot. Type species *Simia rosalia* Linnaeus.



Golden-headed lion tamarin *L. chrysomelas*

Neither Lesson nor Wagner had declared a “type species” for the genus. A type species is the animal model that is the conceptual basis for the group. Specification of a type species later became a requirement of the naming process, and this sent many taxonomists off to designate retroactively type species where none were published. Efforts to do this to validate Lesson’s and Wagner’s names only added confusion. Years later, finding the right name to go with the right species to represent the right concept is no easy task in the poorly charted nomenclatural sea.

To make things just a little more complicated and confusing, after Lesson and Wagner, two additional exclusive generic names were attached to the lion tamarins. The first was a variation on the old pre-Linnaean theme, *Leontideus*, which freely translated means lionlike.

By comparison, the fourth name, *Marikina*, came out of left field. According to Philip Hershkovitz of Chicago’s Field Museum of Natural History, who probably knows more about these matters than any other living zoologist, *Marikina* is a play on the French word Marignon, a reference to the Rio Marañon of Peru, where some of the first specimens of lion tamarins were supposed to have been collected. Unfortunately, the authentic *Marikina* could not be a lion tamarin because they have never occurred in Peru. In addition, the name *Marikina* had already been reserved for Amazonian bare-faced tamarins, albeit incorrectly, for *Saguinus* beat it out by more than 50 years. And so it goes....

Lion tamarins bounced back and forth in the literature under various titles for more than 200 years. At my last count, at least eight nonexclusive generic names seem to have been affixed to them mistakenly. Between 1800 and 1850,

their tangled taxonomy was shared with a diverse cast of species from all over South America under 10 different generic names.

Finally, in a two-stage process beginning in 1956, which I hope will be the last episode of this series, the great sages of New World monkey nomenclature paved the way for the belated triumph of “*Leontopithecus* Lesson, 1840,” as the name is recognized technically.

The Argentine mammalogist Angel Cabrera determined that Wagner’s *Leontocebus* could not be applied properly to lion tamarins. It belonged with saddle-backed tamarins from Colombia, also of the *Saguinus* group. Thinking that *Leontopithecus* had the same type specimen, Cabrera also rejected the validity of Lesson’s name and proposed *Leontideus* as an alternative. Little more than a decade later, however, Philip Hershkovitz validated the priority of *Leontopithecus* by finding that, in 1917, Reginald I. Pocock had explicitly tagged the type species *rosalia* to it, in proper fashion. Actually, Pocock’s objective was a retroactive fix on behalf of James Gray, not Lesson, who in 1870 used *Leontopithecus* in much the same context as Lesson, as it is used today. Let *Leontopithecus* stand!

The Latest Twist

But for how long? Two years ago, an astonishing discovery was made a few hundred kilometers south of Rio de Janeiro, in the Brazilian states of Parana and Sao Paulo. A new tamarin population was found in a rarely visited national park. It was the first such discovery since the golden-headed lion tamarin (GHLT) of Bahia, *chrysomelas*, and the black lion tamarin (BLT) of Sao Paulo, *chrysopygus*, made their appearances in 1820 and 1823, respectively, to set off this lengthy round of

Picture Imperfect

This lithograph from the collection of Russell Mittermeier, a primatologist and president of Conservation International, is part of the folklore of *Leontopithecus*. It stems from German naturalist Alexander von Humboldt's first description and illustration of *Simia leonina* in 1805.



This was the animal, mentioned in the text, that Cabrera reidentified as the saddle-backed tamarin *Saguinus* after it had been confused with lion tamarins for many years, probably because of its lionesque title.

The portrait was reprinted and re-tinted in the literature, a Victorian indulgence that mocks its scientific value. But the original artist never saw the actual specimen. He worked from Humboldt's field notes and probably other illustrations of small New World monkeys, and thus created a lovely piece of natural history art that makes no sense at all today.

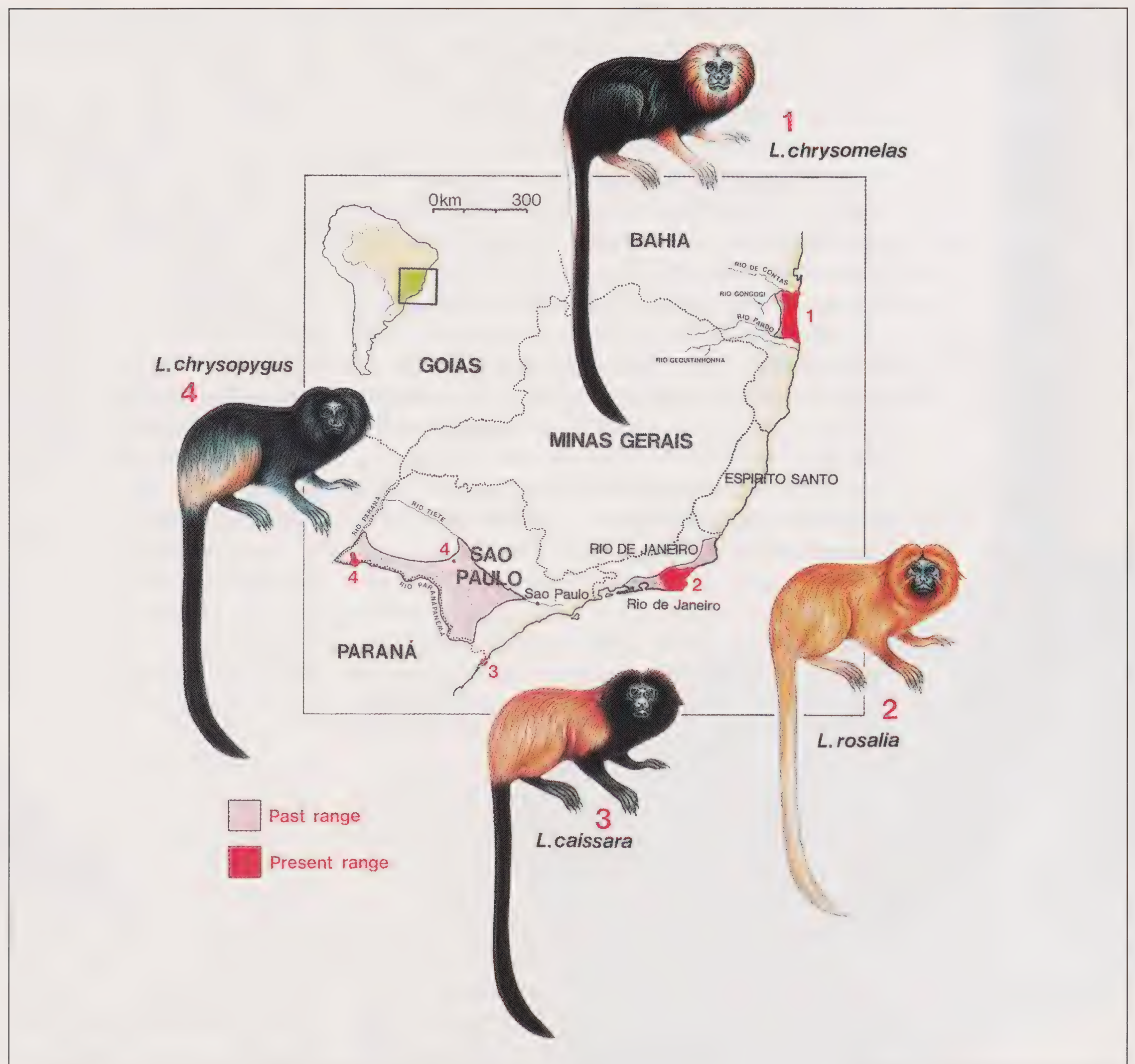
To Cabrera's credit, this monkey does show the black-and-white face of the saddle-backed tamarin, but where's the saddle? Was

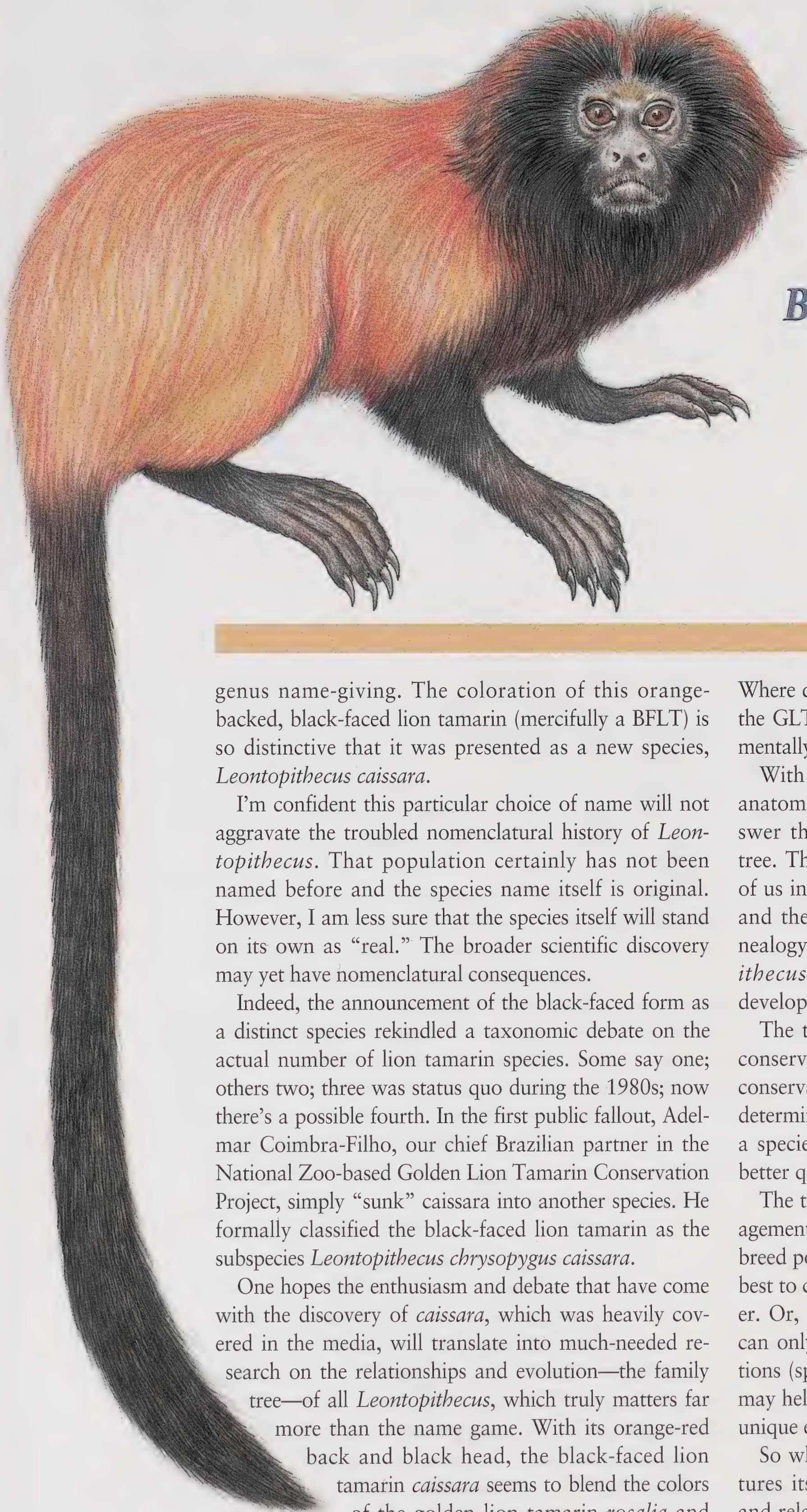
Cabrera right? In fact, Mittermeier thinks the artist was thinking of a pygmy marmoset, *Cebuella pygmaea*. This marmoset occurs in the river basin where Humboldt traveled. The fur on our monkey's back, trunk, and tail resembles the shadowy, olive-gray cross-striping of *Cebuella*, and the tail's shape is similar to that of *Cebuella*. Pygmy marmoset faces are even mottled in gray, black, and white.

And there are other clues. The prop, that stunted ear of corn: *Simia leonina* is not much larger than it, and neither is *Cebuella*. Oh, yes, there's also the name. Humboldt called it *leonina* in fine Euro-Linnaean style. But today in Spanish-speaking Peru—and I suspect it wasn't much different 200 years ago—the locals call pygmy marmosets "leoncito," which means, obviously, little lion.

In any case, even if Humboldt had intended this monkey to be *Cebuella pygmaea* and Cabrera got it wrong, the book on *Simia leonina* was already closed by 1805. You see, George Shaw in 1800 had used the same name combination for a Sri Lankan langur, now, of course, known by another quite exact name, *Presbytis johnii*. But that's another story.

—Alfred L. Rosenberger





Black-faced lion tamarin *L. caissara*

genus name-giving. The coloration of this orange-backed, black-faced lion tamarin (mercifully a BFLT) is so distinctive that it was presented as a new species, *Leontopithecus caissara*.

I'm confident this particular choice of name will not aggravate the troubled nomenclatural history of *Leontopithecus*. That population certainly has not been named before and the species name itself is original. However, I am less sure that the species itself will stand on its own as "real." The broader scientific discovery may yet have nomenclatural consequences.

Indeed, the announcement of the black-faced form as a distinct species rekindled a taxonomic debate on the actual number of lion tamarin species. Some say one; others two; three was status quo during the 1980s; now there's a possible fourth. In the first public fallout, Ademar Coimbra-Filho, our chief Brazilian partner in the National Zoo-based Golden Lion Tamarin Conservation Project, simply "sunk" caissara into another species. He formally classified the black-faced lion tamarin as the subspecies *Leontopithecus chrysopygus caissara*.

One hopes the enthusiasm and debate that have come with the discovery of *caissara*, which was heavily covered in the media, will translate into much-needed research on the relationships and evolution—the family tree—of all *Leontopithecus*, which truly matters far more than the name game. With its orange-red back and black head, the black-faced lion tamarin *caissara* seems to blend the colors of the golden lion tamarin *rosalia* and the black lion tamarin *chrysopygus*, both virtually neighbors. Is the BFLT a missing link between the GLT and BLT branches? Are GLTs more closely related to BLTs or to BFLTs? Or, do the BLTs go with the BFLTs?

Where do the far-north GHLTs fit in? Are they twigs of the GLT, BLT, or BFLT branches, or are they a fundamentally separate bough of the *Leontopithecus* tree?

With new techniques to examine their genetic and anatomical characteristics, we may soon be able to answer these questions about the lion tamarin family tree. These issues are being looked at now by a team of us in the Zoo's Department of Zoological Research and the Molecular Genetics Laboratory. A good genealogy of all the LTs is a key piece of the *Leontopithecus* puzzle missing from previous attempts to develop a sound taxonomy.

The tree's shape will have strategic implications for conservation, and the debate may pit science against conservation politics because taxonomy is one basis for determining conservation needs. In some circles, saving a species from extinction is vital, but subspecies had better queue up.

The tree's shape will also affect decisions about management in zoos. If there is a need, for instance, to interbreed populations (or subspecies) in zoos, it is obviously best to combine those most closely related to one another. Or, in the worst of cases, if our financial resources can only support preservation of two or three populations (species or subspecies), genetics and phylogenetics may help us set priorities. We may wish to save first the unique evolutionary lines.

So what's in a name? A lot. An animal's name captures its essence and reflects its evolutionary history and relationships. And, for endangered species like the lion tamarins, this may well determine whether they live or die. ♣

Alfred L. Rosenberger is a research fellow in the Zoo's Department of Zoological Research.

PARADISE

in peril

"A ghoulish wail shattered the early morning calm. Had I not been hiking in a highland forest, I'd have guessed the eerie calls were cetacean vocalizations—they had the ring of hump-back whale songs. Resonating through the forest, the sounds grew louder. I sat motionless against a huge tree, hoping to catch a glimpse of the singers. Suddenly, three creatures bounced, kangaroo-style, into view. With acrobatic grace, they launched off tree trunks 30 to 40 feet high and leaped equal distances through the canopy.

My stillness was rewarded when two of the creatures landed in 'my' tree and peered fearlessly into my eyes. Black and white, with teddy bear faces, they suggested evolutionarily gone-wrong miniature giant pandas. But I found these unique animals even more appealing."

Although this sounds like fantasy, it is, in fact, an account of my first encounter with the extraordinary babakoto of Madagascar. The babakoto, or indri, is the largest member of

the lemur family, a group of 30 species of primitive primates found only on that magnificent island. Rereading my ragged field notes of several years ago, I became enthusiastic about returning to Madagascar to search once again for the elusive indri—and to see many of the other lemurs.

So, when I was asked to lead a nature tour to Madagascar I jumped at the chance. Located in the Indian Ocean, Madagascar is the world's fourth largest island. It is also a naturalist's paradise, and has been for centuries. In 1771, French naturalist Philibert Commerson wrote, "Nature seems to have retreated there into a private sanctuary, where she could work on different models from any she has used elsewhere. There, you meet bizarre and marvelous forms at every step."

The Madagascan landmass broke away from continental Africa about 160 million years ago, during the early stages of mammalian evolution. Plant and animal species

Opposite page: White-footed sportive lemur.

Story and photos by Craig Sholley





Ring-tailed lemurs are largely terrestrial, but take to the trees when alarmed.

crossed the then narrow Mozambique Channel from Africa to the island, but as the channel widened such movement of African species ceased. In eons of geographic isolation, a highly distinct Madagascan flora and fauna evolved. As a result, today Madagascar tenuously supports a large percentage of the world's biodiversity. And many of its species are endemic—found nowhere else in the world.

Madagascar boasts some 6,700 species of endemic plants, including the national symbol, the traveller's palm, and an incredible variety of aloes and euphorbias. The

faunal statistics are even more amazing. Of the island's 300 species of butterflies and moths, 233, or 78 percent, are endemic. Two-thirds of the world's 90 species of chameleons, including the smallest and the largest, occur only on Madagascar. Among the island's 256 species of birds are 105 endemics. As for the mammals, *all* are endemic, including the entire family of 30 lemur species, one of which was first described as recently as 1989.

Lemurs are prosimians, which means they are primitive members of the primate order that includes monkeys, apes, and hu-

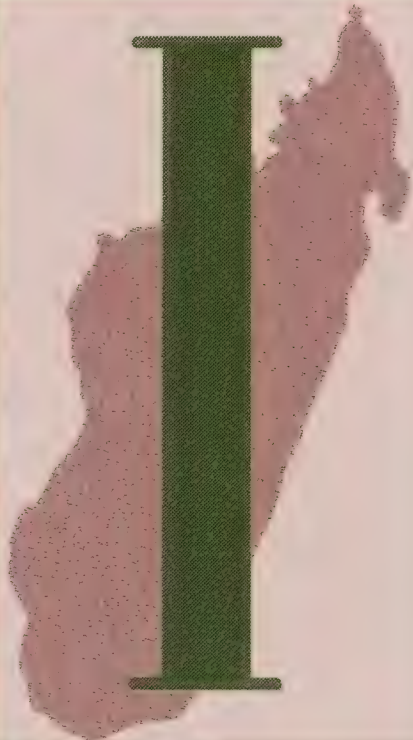
mans. Evolving on Madagascar without competition from other primates, lemurs radiated into a group of diverse species occupying virtually all of Madagascar's varied habitats. In size, lemurs range from the tiny, two-ounce brown mouse lemurs to the 20-pound indri. Diets include leaves, fruit, flowers, bark, bamboo shoots, and insect larvae. Social structures range from solitary, through small family groups with monogamous adults, to large mixed-sex groups of 15 or more. However, all but a few species are largely nocturnal and arboreal. Lemurs travel, feed, and sleep in trees, and, even in species in which individuals occasionally venture to the ground, they return to the heights to rest or escape danger.

In Search of Lemurs

One of the goals of the tour I led to Madagascar was to see as many lemur species as possible. The members of my group of 15 amateur naturalists ranged in age from 35 to 80, and included a dentist, accountants, a court stenographer, a restaurant manager, and a celebrated moth and butterfly illustrator. Brought together by the allure of Madagascar, we crisscrossed the Texas-sized island, exploring such diverse habitats as the central high plateau region of Ranomafana National Park, with its high-altitude forests, the spiny desert surrounding the Berenty Reserve at the southern end of the island, the evergreen forests and coastal beaches of Nosy Be, an island off the northern coast, and, finally, the moist, montane forests of Perinet Reserve in the eastern part of the island.

We started our journey in Antananarivo, the country's centrally located capital. Brightly colored houses stacked up on the hillsides adorn this picturesque town. Rice paddies are tended right up to the city's edge. Once outside of the city, traveling south, modern technology and signs of Western influence disappear, but people and their works do not. Villages and herds of grazing zebu cattle dotted the landscape. On the road, people drive traditional ox-carts to transport rice and wheat from the fields. Our journey afforded panoramic views of granite-domed mountains, grassy hillsides, and a verdant mosaic of rice paddies and cassava fields. There is, however, no natural forest to be seen.

But, after a long day's drive from the capital, winding down a road that parallels a spectacular forest stream and its series of



In eons of geographic isolation, a highly distinct Madagascan flora and fauna evolved. As a result, today Madagascar tenuously supports a large percentage of the world's biodiversity.

magnificent waterfalls, we entered a forest of trees thickly laden with ferns, mosses, and other epiphytes. This is the edge of Ranomafana, one of Madagascar's most recently declared national parks. Our search for lemurs was about to begin.

The next three days began early and ended late. Heading out before dawn, the bird enthusiasts in our group were quickly rewarded with dozens of additions to their life lists. Lemur sightings followed as we hiked deeper into the forest. Just as birders pursue calls to find birds, we pursued distant childlike vocalizations and discovered small groups of red-fronted lemurs and red-bellied lemurs feeding above us in the canopy. Cat-sized and cautious, they moved expertly from tree to tree. Peeking around leaves and branches, they briefly

studied us, then stealthily disappeared from view. Luck was with us—both of these species are among the few lemurs that are active during the day. And our luck held out when a late morning hike led us to a trio of diademed sifakas, large and beautiful lemurs related to the indris that are also active during daylight.

The results thus far had amply justified our strenuous hikes, but our nighttime forays proceeded in a somewhat different fashion. With headlamps strapped to our foreheads and powerful spotting lights in hand, we stumbled through the darkness in pursuit of nocturnal species. The prize this time was smaller but equally intriguing. In a forest clearing, the branches above us suddenly came alive with scurrying brown mouse lemurs. They were everywhere! Ac-

Like most of the larger lemurs, the Verreaux's sifaka is active during the daytime.



Gray mouse lemur at the Berenty Reserve.

customed to regular human intrusions (the area is a Duke University Primate Center field research site), the tiny omnivores leapt from branch to branch, obliging us by taking center stage in the light beams.

The Oasis of Berenty

From Ranomafana, we backtracked about 50 miles to Fianarantsoa to catch a flight to Madagascar's southern tip. Flying below the clouds, we saw the extent of the ecological catastrophe the island is experiencing. Even those earlier miles through deforested and densely populated country hadn't prepared us for the rivers that run brown and red—the colors of the eroding countryside. Barren of trees except for a few strips of riverine forest or pockets of introduced eucalyptus, the land is farmed to the very peak of every hill and mountain.

The deforestation of the plateau that dominates the center of the island has been in progress since people first settled Madagascar about 2,000 years ago and began cutting the forest for their farms. Today, slash and burn agriculture, as well as a thriving hardwood extraction industry, threatens to finish off what little forest remains. Human impact long ago led to the extinction of a dozen or more species of lemurs, including giant lemurs the size of orangutans, as well as many other Madagascan species such as the half-ton elephant bird. Now, deforestation threatens the survival of the remaining lemurs and a long list of other endangered species.

Heading south off the plateau, we watched as the landscape changed to the dry, mysterious desert that makes up much of Madagascar's southern region. Then, suddenly, the azure waters of the Indian Ocean appeared as we landed in the port

city of Fort Dauphin. From Fort Dauphin, we traveled by bus back into the desert we'd seen from the air.

The coastal fringe of white-sand beaches quickly gives way to an impenetrable tangle of spiny *Alluaudia* trees. Reaching heights of more than 45 feet, *Alluaudia*, known as the octopus tree for its thorny, armlike branches, dominates the region. But, occasionally one sees a bulky baobob, and, surprising to all of us, we came upon scattered pockets of carnivorous pitcher plants.

Incongruity is the norm in this desolate region. As our van rounded a curve in the road, we came upon a series of 15-foot-tall obelisks—sort of miniature Washington Monuments standing next to the two-lane highway. Scattered among them, and in stark contrast to the bare concrete of the obelisks, stood intricately carved wooden statues and totems. As we stared incredulously, a Malagasy friend explained that this is a burial site. The carved wooden stelae depict important scenes in the life of the deceased. And, we discovered that the tombs are more elaborate and better built than any house in the region. Death, we learned, is the most venerated stage of a Malagasy's life.

Tucked in the middle of the inhospitable desert we found an oasis: the privately owned Berenty Reserve, a 0.4-square-mile gallery-forest sanctuary that is home to six endangered lemur species. Berenty's bungalows offer truly luxurious accommodations to weary lemur-searchers. And, as if by design, soon after we were comfortably installed, the lemurs went on parade. Seeing lemurs at Berenty was effortless—they came to us.

Troops of ring-tailed lemurs, a largely terrestrial species, marched through the compound regularly, making catlike calls as if to alert us that they were on their way. Photo-



Black lemurs are one of the few sexually dimorphic lemur species.

genic infants clung tightly to their mothers' backs, eyeing us curiously as their moms strode arrogantly by. Numbering 15 to 20 individuals, the female-led groups interacted easily with their human distant cousins.

As photogenic, but less approachable, were the Verreaux's sifaka who frequented the trees growing around the bungalows. Small family groups spent the early morning hours sunbathing, with arms outstretched and faces tilted toward the heavens. Later, having warmed up, the eight-pound sifakas leapt through the trees to feed on the leaves that make up most of their diet. These sifakas seldom come to the ground, but their rare terrestrial escapades are laughable: Balancing bipedally, with

their short arms waving frantically, they resemble happy partygoers wandering home after a few too many brews.

Some of Berenty's other lemurs took a little more work. In treks through the forest at dawn and at night, we caught a few glimpses of the secretive white-footed sportive lemur, which at under two pounds is capable of leaping 15 feet from tree to tree. In contrast, tiny gray mouse lemurs were ubiquitous in the dark forest.

Lemurs weren't the only rewards. Endemic birds, such as giant coua, vasa parrots, and hook-billed vangas awakened us with their dawn choruses. And at dusk, the evening sky filled with the eerie silhouettes of flying foxes, huge fruit bats taking off on foraging forays.

Nosy Be and Perinet

A 1,000-mile flight the length of the island took us to our next destination: Nosy Be, a tiny island off the northern coast of Madagascar. With brilliant blue waters and black and white sand beaches, Nosy Be is a beach bum's paradise. But, faithful to our mission, we set off in search of new lemur species. Black lemurs are the stars of Nosy Be. One of the few sexually dimorphic lemur species, black lemur males are a majestic jet black, while females boast bright

Ecotourists pay handsomely to see these striking animals in their forest domain. For this reason, villagers treat black lemurs like celebrities, and carefully protect both the lemurs and the forest.

chestnut-brown coats and wonderful white facial manes.

Ecotourists pay handsomely to see these striking animals in their forest domain. For this reason, villagers treat black lemurs like celebrities, and carefully protect both the lemurs and the forest. The islanders have also habituated family groups of black lemurs, so we were not disappointed by our trip via dugout canoe to Lokobe Reserve. The village guides led us directly to a large family group lazily immersed in a mid-morning grooming session.

In Lokobe we also came across Madagascar ground boas and a diverse array of chameleons. Peering down from his daytime resting place in a banana tree, a gray-backed sportive lemur drowsily acknowledged our presence. Then we gave in to the allure of the beach. And, swimming and snorkeling in the crystal-clear water, we discovered yet another facet of Madagascar's natural wonders as fluorescent fish and other colorful marine creatures flashed before us.

The last leg of our journey took us to the moist eastern forests of Perinet Reserve, home of the indri. Arriving near dusk, we had no hope of seeing the strictly diurnal indri that first day. But that didn't prevent us from taking another lamp-lit nocturnal stumble through the forest. Once again, our efforts were rewarded. Our lights fell on the fire-red eyes of greater dwarf lemurs moving silently through the trees, and revealed a pair of avahi, or woolly lemurs, secretively socializing near the ground. Woolly lemurs, two-pound relatives of indris and strictly nocturnal, are only rarely seen, and our good luck that night primed us for the next morning's search for indris.



The beach bum's paradise of Nosy Be.



Two-thirds of the world's 90 chameleon species occur only on Madagascar.

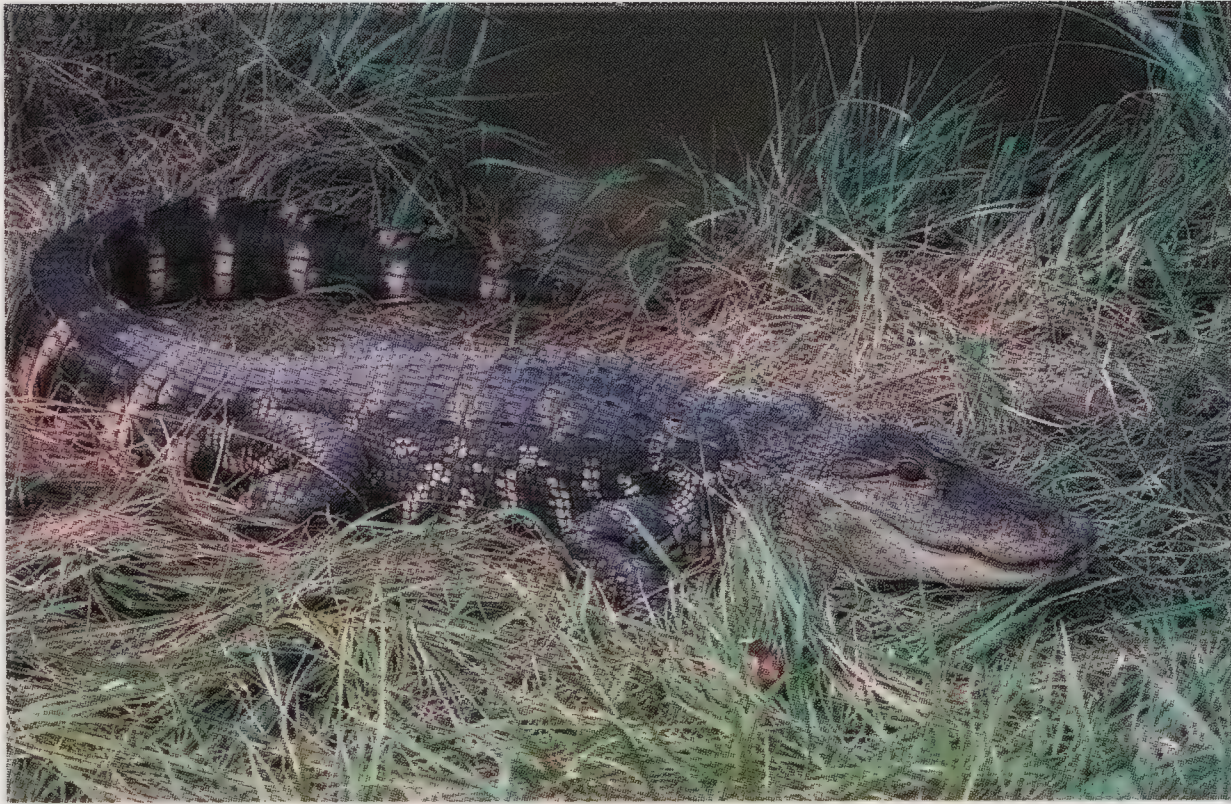
With only a few hours of sleep, we set forth into the foggy, dripping-wet forest. Small family groups of indris live in territories that they defend from others with group howls. Typically, families alert others to their presence by bellowing ghoulishly every morning at sunup. So, as we hiked sleepily through the silent, damp forest, we listened carefully for the songs, which can be heard from more than a mile away.

The fog began to lift and sunlight filtered through the leaves to the forest floor. Suddenly, birds began to sing, breaking the silence. Nearby, an indri family erupted into song and, as if the sound was infectious, another more distant group followed suit. We were scanning the canopy when a family of three bounded into view some 20 feet above us. As we watched, the female and her infant stared at us in surprise. It was a touching moment for all of us. Their surprise seemed to represent the tenuous

nature of their existence—the fragility of their species, the forest, and indeed of all life on Madagascar. We hoped their irresistible appeal would move people to protect them, and contribute to Madagascar's environmental salvation.

In three short weeks, our group had seen 13 species of lemurs. We'd discovered not only their unique beauty and charm, but also the fragility of their existence and the uncertainty of the island's future. Without immediate revenue-generating conservation ventures, and many more examples of Malagasy people benefiting from wildlife, this Madagascan paradise will be irrevocably lost. ♣

Craig Sholley, a former Baltimore Zoo curator and former director of Rwanda's Mountain Gorilla Project, is a wildlife biologist who consults on subjects ranging from conservation biology to wildlife filmmaking and international ecotourism.



Alligator at the National Zoo. (Jessie Cohen/NZP)

Game Wars: The Undercover Pursuit of Wildlife Poachers. 1992. Marc Reisner. Viking Penguin, New York. 294 pp. softbound, \$11.00.

Game Wars: The Undercover Pursuit of Wildlife Poachers is the most raw and disturbing account of the real world of wildlife law enforcement I have ever encountered. From discussions with colleagues who are highly experienced wildlife managers in this country and around the world, I found they too were astounded at the revelations in this book. *Game Wars* will be required reading and a major seminar topic for the next generation of wildlife managers. It is also a great read, and will be appreciated equally by fans of hard-boiled detective stories and anyone interested in wildlife.

Game Wars documents the scope and extent of wildlife poaching, and of the illegal marketing of wildlife and wildlife products in this country, as well as the efforts of the small number of brave in-

dividuals to stop, or at least contain, the criminals involved. It focuses on the undercover operations of one veteran U.S. Fish & Wildlife Service agent, Dave Hall, who is based in Louisiana. And reading about what Dave Hall has done as an undercover wildlife "cop" left me feeling like my own wildlife conservation activities have been the equivalent of going to a church social compared to what is really going on out there.

A basic precept in wildlife conservation as practiced in our country has been that gross takes by those few who kill wildlife for a market destroy or spoil the wildlife resource for everyone else. Much of our conservation history concerns eliminating market hunting and controlling harvest levels so habitats sustain wildlife for sport hunting and fishing. I know we continue to face major problems in maintaining wildlife habitats, but I thought that wildlife poaching and the trade in wildlife parts and

products was under control, domestically if not internationally. I was wrong. And, in *Game Wars*, author Marc Reisner shows us that what success there has been in wildlife protection in the United States has come at great personal risk and cost to the officers involved. He also reports some disturbing failures.

Reisner, formerly with the Natural Resources Defense Council, tells his story in four parts. Three of them detail Dave Hall's and his associates' undercover efforts to stem poaching and trade of alligator, walrus, and sacalait (white perch). Reisner himself participated in some of the sacalait operations. The alligator and sacalait stories, both set primarily in Louisiana and Mississippi, are a tribute to successful U.S. Fish & Wildlife Service undercover operations. They describe the teeth in our wildlife protection legislation—the men and women who understand and care about wildlife management principles and put their lives on the line because they believe alligators and sacalait belong not to a few for personal gain, but to all of us.

The walrus ivory story tells a different tale. When these same men and women moved beyond the familiar haunts of their southern bayous and took on the international trade in ivory, they were clearly in over their heads and lucky to get out alive. I had considered ivory poaching an African and Asian problem; I now know it is a North American problem.

And it is a big, dangerous, and complex business. Thousands upon thousands of walrus have been shot for their tusks in Alaska. Major processing centers are not just in Hong Kong and points west, but also in Hawaii. Resolving the problem of walrus overharvesting is made all the more difficult by issues of rural poverty, North American Indian rights, local rights, and national and international jurisdiction over wildlife products from endangered species. The ivory wars are far from over.

In the fourth part of the book, "Loss," Reisner recounts how much of our original wildlife abundance has been lost and tries to identify the most important processes involved in that loss. He uses as a case study the recent massive loss of Louisiana coastal wetlands as wildlife habitat through the unwitting collaboration of, among others, the Army Corps of Engineers. Reisner concludes that, even if it takes heroic individual efforts, the direct killing of wildlife can be contained in most instances. The loss of wildlife habitat is far more insidious. Resolving this crisis is a problem of scale: Massive changes in wildlife habitats have been created by societal processes and it will take all of us to recognize the value of wildlife habitat and to stem its continued loss.

—John Seidensticker
Curator of Mammals

Game Wars is available in the National Zoo Bookstore.

Seal Days

Northern elephant seals will star at FONZ's annual Seal Days, set for Saturday and Sunday, March 6 and 7, at the Zoo. Largest of the pinnipeds, northern elephant seals (*Mirounga angustirostris*) represent a conservation success story. Elephant seals breed on the coast and offshore islands of California and Baja California, where their lumbering locomotion made them easy pickings for sealers. Once numbering from 100,000 to 200,000 animals, by 1892, after nearly a century of slaughter, perhaps as few as 20 or 30 elephant seals were left. But with the collapse of the seal trade (seals had become so scarce, it was no longer economical to hunt them) and subsequent protection by the governments of the United States and Mexico, elephant seals slow-

ly recovered. Scientists estimate the current elephant seal population at more than 130,000 and growing.

To learn more about seals and their marine habitats, come to the Zoo on Seal Days for a full schedule of special exhibits, films, tours, and demonstrations. Most activities take place near the seal and sea lion pools in Beaver Valley. For more information, please call 202.673.4717.

Orang Shebang!

This year's ZooFari featuring primates promises to be (irresistibly) more fun than a barrel of monkeys! Set for the evening of May 20, Orang Shebang will be FONZ's tenth gala benefit for the Zoo's Theodore H. Reed Animal Fund. Offering a sumptuous array of food from more than 80 area restaurants, entertainment by near-

ly a dozen artists, including rhythm and blues legend Chuck Jackson, and a festive evening with the Zoo's animals and party animals, ZooFari is an event not to be missed. Individual tickets cost \$85 for FONZ members and \$100 for nonmembers.

But ZooFari is such a great party, you may want to share it with friends, colleagues, and clients at a reserved table for 10. The table price of \$1,400 includes valet parking for you and your guests and special food and beverage service at the table. Your name or your company's name will also be listed in the ZooFari program. A limited number of tables hosted by a National Zoo zoologist, who will offer your group a behind-the-scenes tour of an animal area, are also available for \$1,800. For more information and to reserve your tickets or table, please call 202.673.4961. ZooFari is being supported in part by The Coca Cola Company and the Coors Brewing Company.

Black History Month

Many Smithsonian museums are celebrating Black History Month with special programs. The Zoo is hosting a film series, "Unalienable Rights: The Pursuit of the American Dream," with films being screened at 1:00 p.m. on each Saturday in

February. On February 6, the featured films are *A Singing Stream: A Black Family Chronicle*; *Niambi, Sweet Melody*; and *A Well Spent Life*. *Fundi* and *Color Us Black* will be shown on February 13. On February 20, there will be four films for and about children: *Extra Change*; *J.T.*; *Sound of Sunshine*, *Sound of Rain*; and *The Blue Dashiki: Jeffrey and His City Neighbors*. And on February 27, *Miles of Smiles*, *Years of Struggle*, and *Black Men and Iron Horses*. Films will be shown in the Zoo's Education Building Auditorium. For more information on the series and other Black History Month programs, please call 202.357.4574.

TRANS BRASIL A I R L I N E S

The National Zoological Park wishes to recognize the generosity of Trans Brasil Airlines for its contribution of \$25,000 worth of round-trip airline tickets from Washington, D.C., to Brazil. These tickets will support expeditions to Brazil as part of the Zoo's Golden Lion Tamarin Reintroduction Program. As a primary supporter of this exciting program to save the GLT from extinction in the wild, FONZ welcomes this generous assistance from Trans Brasil Airlines.



Northern elephant seal. (Daniel Haut)

Big Kicks at the Bird House

"They kill more people each year than polar bears do." "One swift kick can rip open your abdomen." Comments about tigers, or sharks, perhaps? No, the subject is a bird. A BIG bird, a double-wattled cassowary to be exact.

The National Zoo is home to two of these unusual creatures, which live in separate enclosures in one of the park's most peaceful areas: behind the Bird House, along the walk, just past the ostriches and flamingos. The pair of double-wattled cassowaries (*Casuarus casuarinus bicarunculatus*) are young—both were born in July 1991. The female, from the Denver Zoo, arrived here in December 1991, and the

male, from a breeding farm in California, joined her this past September. (His airfare was courtesy of the Theodore H. Reed Animal Fund, supported by ZooFari proceeds.)

Cassowaries are ratites, a group of flightless birds that includes the extinct moas of New Zealand and elephant birds of Madagascar, as well as the living South American rheas, African ostriches, New Zealand kiwis, and Australian emus. The three species of cassowaries are closely related to emus, but scientists are not sure how or even whether these species are related to other flightless birds.

Because the claws, long skinny necks, huge eyes, prominent beaks, and muscular scale-covered legs of ratites look primitive, scien-

tists once speculated that they are among the most ancient of birds, perhaps the direct descendants of dinosaurs and the precursors to flying birds. Unfortunately, the fossil record is sparse as the delicate bones and feathers of birds do not fossilize well. The oldest cassowary fossil dates only from the late Pleistocene (10,000 to 50,000 years ago), and the few ratite specimens that have been found shed little light on their evolutionary history.

An examination of the skeletal structure of modern ratites indicates, however, that ratites are not the evolutionary link between dinosaurs and birds. In fact, ratite ancestors flew. Their wing structure is very similar to that found in other birds and it appears that they lost their ability to fly as their body size increased. This in turn led to changes in bones, muscles, and plumage. Their wing muscles are weak and unable to support flight because the breastbone lacks a place for the attachment of wing muscles. To compensate for flightlessness and to defend themselves against potential predators, ratites have strong, powerful legs. They can run fast—cassowaries, for example, reach speeds of 30 miles per hour. And cassowaries, as well as ostriches, pack powerful, even lethal, kicks.

Cassowaries have been exhibited in the West since 1597, when the first living cassowary arrived at an Amsterdam menagerie. Their common and scientific names come from the Malay word for the bird, "kesuari." Thomas Wall, a British explorer and naturalist who joined an expedition to Australia, was one of the first Europeans to see cassowaries in the wild. He published the first scientific description of the birds in 1854, although he lost his specimen—it was left in a bag on the shore of an Australian bay.

Cassowaries have been exhibited at the National Zoo almost since its inception. A cassowary arrived in 1893, one of many animals that Samuel Langley, Secretary of the Smithsonian, acquired from the Adam Forepaugh Circus.

The double-wattled cassowary lives in the low swamps and rainforests of northern Australia and New Guinea. Two other species are found in New Guinea, and live in both lowland and mountain forests. Watermelon-sized shortly after hatching, cassowaries reach five feet in height and weigh up to 130 pounds when they are fully grown. They swim well and in the wild are often found near riverbanks.



Adult double-wattled cassowary at the National Zoo. (Jessie Cohen/NZP Graphics)



Immature cassowary. (Jessie Cohen/NZP Graphics)

The Zoo's young birds are covered with fluffy, narrow, dark-brown feathers that have a hairlike appearance. The feathers, like those of other ratites, look fluffy because the parts of the feather called barbs, which jut off the shaft, are not hooked together with the tiny barbules that link the individual barbs in flying birds. Anyone who has smoothed the ruffled feathers of a nonratite knows how the individual strands of the feather cling together. In contrast, ratites' feathers, which do not need to be stiff to push against the air in flight, allow the air to flow through.

The rather dull coloration of the Zoo's cassowaries will give way to vibrant hues as they mature. Already, a greenish-blue color tints the skin around their eyes. The dark-

brown feathers will become shiny black. Their necks are sparsely covered with down now, but, by the time they are three years old, this will be transformed to extravagantly colored deep blue and scarlet skin. The wattle (a flap of loose skin extending like a bib from the bird's neck) will turn blue at the base, graduating into a deep pink farther down.

The bumps on the top of their heads are the beginning of the casque, a hard, helmet-like structure made of keratin that crowns the cassowary. One of the reasons the cassowaries were thought to be related to dinosaurs is that although very few vertebrates have casques, many dinosaurs did. The double-wattled cassowary's tall and bladelike casque is not merely decorative—the bird lowers its head

and pushes through dense forest, using the casque to clear a path through the tangles. Cassowaries in zoos have also been seen using the casque to dig up buried food items.

In the rainforest, these birds eat fruit that has fallen to the forest floor, supplemented by insects, fungus, roots, and small vertebrates. Zoo-dwelling cassowaries are fed bird pellets, along with apples, oranges, and bananas. As they get older, a bit of meat will be added to their daily diet.

The cassowary's extremely powerful kick is all the more dangerous because the bird's toes are tipped with sharp, daggerlike claws. The claws are lethal weapons and are even used by tribal people in New Guinea as spear points. Nonetheless, cassowaries are shy, solitary birds that, despite their size, are rarely glimpsed in the wild.

In the wild, male and female come together only briefly during the August and September breeding season. Zoo breeding programs are delicate affairs: Male and female must be carefully put together each day, and if the timing isn't perfect, serious fights may occur. The male makes purring sounds to interest his mate, but if the female isn't ready, she will fight him off. Unusual among birds, females are

slightly larger than males, although the sexes otherwise look alike.

The female lays a clutch of four to ten eggs in a depression in the ground covered with dry leaves and well concealed in the vegetation of the densest part of the forest. Then she disappears from the scene and the male takes charge. He incubates the five-and-a-quarter- by three-and-a-half-inch eggs for about 35 days, then takes care of the young chicks for about a year before resuming his solitary ways.

Although not endangered, cassowary populations were greatly reduced in the late 1800s, when sugar planters destroyed many of the birds and used their skins for hearth rugs and doormats. New Guinea natives hunt them for meat and keep them in cages so they can use the feathers in clothing. Young cassowaries even walk village streets and are allowed to play with children, although as the birds mature they are banished to pens or released into the forest. According to Charles Pickett, the Zoo's associate curator of birds, cassowaries even serve as currency. In the early 1980s, about 20 cassowaries were considered a fair price for a wife in parts of New Guinea.

—Margie Gibson

The Bad News...

The growing trade in wild and exotic fungi may spell trouble for the world's forests. The underground filaments of some fungi species deliver vital nutrients and water to tree roots. The U.S. Forest Service estimates that as many as 3,000 species of fungus contribute to the growth of trees in Oregon and Washington forests. Some fungi are essential to the development of young trees: Douglas firs, for example, depend on matsutake and chanterelle mushrooms.

These and other mushrooms are in high demand, especially in Japan and Europe. A single matsutake mushroom may fetch as much as \$100 in Japan. European customers will pay up to \$1,200 for a kilogram of Oregon white truffles. A good fungus forager can earn \$1,000 a day, and, as business grows, supplies of some mushrooms are already dwindling.

From TRAFFIC Bulletin, October/November 1992.

...The Good News

Over the last century, numbers of migratory fish such as shad and herring have steadily declined in the Chesapeake Bay estuarine system. A major reason has been the construction of dams and other structures on bay tributaries, which block hundreds of miles of historic spawning habitat. Providing passage for fish at these obstructions is a key part of the plan to restore migratory fish to their former abundance.

The U.S. Fish & Wildlife Service and the Chesapeake

Bay Fish Passage Workgroup have developed and implemented a program to remove impediments to migratory fishes in numerous rivers, including the Patapsco, Little Patuxent, Potomac, and James. Since 1987, 17 projects in Virginia and Maryland have accounted for the opening of nearly 100 miles of stream. Several more projects are under construction, and about 20 more are planned.

From Fish and Wildlife News, Fall 1992.

What's In a Name?

Fifteen species of honeyguides comprise the avian family Indicatoridae, a group of mostly African birds. The first species of this group described by Western scientists was the greater honeyguide, which throughout Africa guides human honey collectors to bee nests. After the people smoke out the bees and break open the nest to extract honey, the birds feed on the wax and bee larvae, supplementing their usual diet of insects. Thus, the roots of the common name, as well as the scientific name, *Indicator indicator*, from the Latin *indic*, meaning that which points out.

A study of the behavior of greater honeyguides and the honey-gathering Boran people of northern Kenya reveals fascinating details about a unique human-bird relationship. Either bird or person may initiate a search for honey; the Boran people emit a piercing whistle to call a bird, or a bird may fly close and flit restlessly around a person while uttering a persistent call. Once the people begin to follow, the

bird makes a series of short flights, stopping at intervals to let them catch up, until it reaches the bee colony. As they follow, the Boran can determine from the bird's behavior, how far the nest is, in what direction it lies, and when they have reached it.

Honeyguide's really help the gatherers: On average, it took about nine hours for the Boran without a honeyguide to find a bee nest in an unfamiliar area, and only about three hours with a guide. The birds, in turn, are less likely to be stung by the smoke-stunned bees, and gain access to many more nests than they could open themselves.

How important human assistance is to greater honeyguides remains uncertain, but, scientists are likely to find the answer to this question soon: Throughout Africa, increasingly easy access to commercial sugar and honey is eliminating the task of wild honey gathering. In many areas greater honeyguides no longer point out anything.

"Precycling"

According to the latest statistics from the Environmental Protection Agency, disposable packaging and containers make up 31.6 percent (56.8 million tons per year) of solid waste in the United States. Paper and cardboard head the list (51 percent), followed by glass containers (23 percent) and plastic materials (12.8 percent).

To cut these numbers, many experts advocate "precycling," involves making environmentally sound choices at the point of purchase, thus

obviating the need for future recycling. For example, consumers can buy fresh fruits and vegetables rather than canned or boxed products. Products such as disposable razors and nonrefillable pens can be replaced with longer-lasting items.

Some manufacturers are beginning to do their part as well. In April, the Recording Industry Association of America will eliminate production of the wasteful "long box" package for compact disks. New CDs will be enclosed in plastic shrink wrap.

From The 1993 Environmental Almanac, compiled by World Resources Institute.

Urban Animal Safari

The Washington area provides habitat for a variety of wild animal artistic creations. These lively, if inanimate, creatures range all over the region, from famous public places to secluded private lairs. Pictured here is one of these fantastic animals—do you know where to spot it? (Look for the answer in our March/April issue.)

Answer to the November/December 1992 Urban Animal Safari: Jefferson Plaza, intersection of Routes 355 and 28, Rockville, Maryland.



(Christy Bowe)

I am pleased to report that 1992 was a great year for Friends of the National Zoo. In part, it was a great year for FONZ because it was a great year for the Zoo. After many years of work, four new BioPark exhibits opened. The Kids' Tiger Stop, the Cheetah Conservation Station, the Reptile Discovery Center, and the Amazonia Habitat Exhibit all are stunning achievements in exhibitry and education that FONZ is proud of supporting. In fact, in 1992, FONZ contributed more than \$180,000 to these exhibits. And new volunteer programs to support them increased the number of FONZ volunteers to nearly 900 people, who worked more than 72,000 hours at the Zoo last year.

I've been lucky to be able to watch the development of these new exhibits. Indeed, one of the benefits of being president of FONZ is that I spend a lot of time in the Zoo. So, I know the Zoo is special, offering a unique combination of educational experiences, opportunities for family recreation, moments of solitude, and close encounters with wildlife. I want everyone to take advantage of the Zoo's great resources. So I am especially pleased at FONZ's continued success in reaching out to new and diverse audiences.

Hosting special events is one way to reach new audiences, and in 1992 FONZ sponsored or cosponsored more special events than ever before. ZooFari's Panda Mania, in May, was the premier event of the year. More than 2,000 people attended the party, acclaimed as the re-

gion's best fundraiser, and we raised more than \$160,000 for Zoo programs. Extensive media coverage brought the Zoo to the attention of virtually everyone in the area.

Other events also attracted attention. Winterfest, Easter Monday's Celebration of an African American Tradition, Seal Weekend, Earth Weekend, Children's Hospital Day, and the Fun Fiesta to celebrate Hispanic Heritage Month, and more, all created opportunities to acquaint diverse audiences with the Zoo.

We also go out and find new audiences. Volunteers and staff participated in local environmental activities such as beach cleanups, and told other concerned citizens about the Zoo. Outreach volunteers took displays about wildlife conservation to neighborhood fairs and other community events. And our holiday Zoo Store at White Flint, as well as displays at local hotels, helped create greater awareness of the Zoo and all it has to offer. But always, the goal is to bring people to the Zoo.

Some people, however, simply can't get to the Zoo on their own—and all they really need is a ride. So, with contributions from FONZ members and a grant from the Ronald McDonald Children's Charities, in 1992 FONZ purchased a new bus. "Zoo Express" was put into service for the summer Zoo Olympics program, bringing 300 inner-city kids to the Zoo for fun educational activities. For many of them, this was their first visit to a zoo. Zoo Express is now transporting schoolchildren to the Zoo daily, and we are

working on a program to bring senior citizens here.

Of course, FONZ does all this with an ulterior motive: our goal is no less than to change the world. Margaret Mead once said, "Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it's the only thing that ever has."

When a small group of thoughtful, committed citizens from Cleveland Park met to form FONZ, they were not trying to change the world. All they wanted to change was their neighborhood's decaying zoo. The wonderful Zoo we have today, nearly 35 years later, is a testament to their—to our—success. But a wonderful Zoo can indeed change the world.

Today we face massive environmental problems. In our own neighborhoods and around the world, habitat quality is declining, natural resources are wasted, and biodiversity is threatened. Locally, FONZ is working to change this, for example, through our recycling programs, which were greatly expanded in 1992. Globally, FONZ's grant support for the Zoo's research and conservation programs, which reached more than \$550,000 in 1992, helps ensure the survival of golden lion tamarins, cheetahs, tigers, and other endangered species.

But where I think we can really make a difference is by reaching out to educate and to inspire people who might otherwise miss the message. We can protect our environment and preserve our world's wildlife only if every-

one is convinced that this is a good thing to do. I believe that a visit to this Zoo, with all it has to offer, helps instill the conviction that will ultimately change the world.

FONZ is committed to wildlife and environmental education. In 1992 alone, FONZ volunteer guides led more than 12,000 students on educational Zoo tours. Our membership department offered more than 125 classes, trips, and safaris to some 2,000 children and adults. Our Zoo Bookstore expanded the number and diversity of its books and educational materials, and even our food containers and T-shirts carry educational messages.

But I believe, with your support, we can do even more. So, in closing let me say a few words about our plans for the future. We have a new mascot—Super Zoodle—who will lead a new program of family activities. These events, fun for the young and the young at heart, will educate on environmental and conservation issues we face daily. We are also beginning a series about zoos and aquariums and their importance.

Finally, because you are members of that small group of thoughtful, committed citizens who can change the world, we want to hear your thoughts on other things we can do. Thank you for your support.

Richard D. Buckner
President, FONZ

The 1993 FONZ Annual Report will be available in April. Please call 202.673.4960 to receive a copy.

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A close-up, high-contrast photograph of a glass filled with Coca-Cola. A large, clear ice cube is melting at the top, with a dynamic splash of the dark, bubbly liquid erupting from the surface. The glass itself is covered in condensation droplets. The Coca-Cola logo is prominently displayed in the center, with the word 'CLASSIC' below it.

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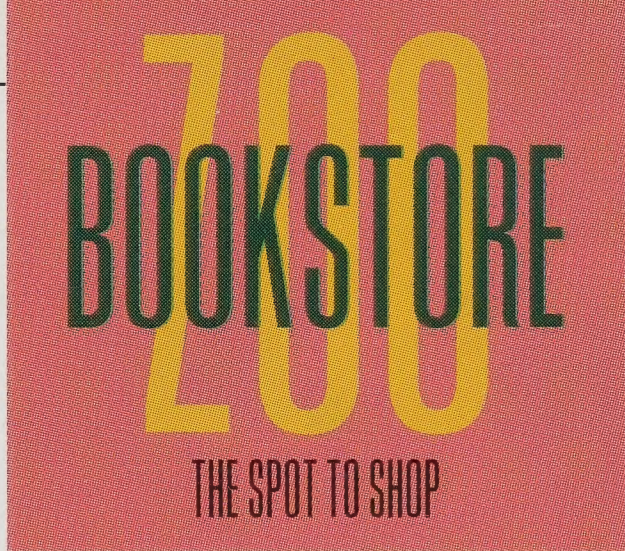
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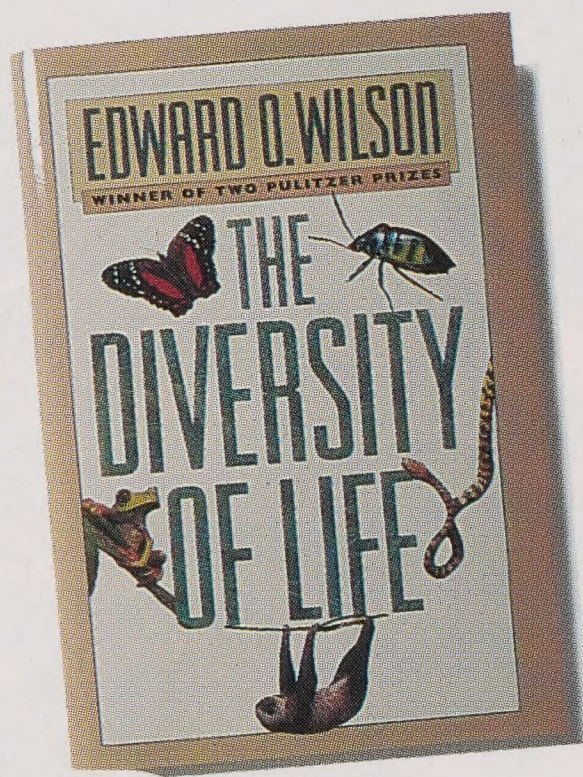
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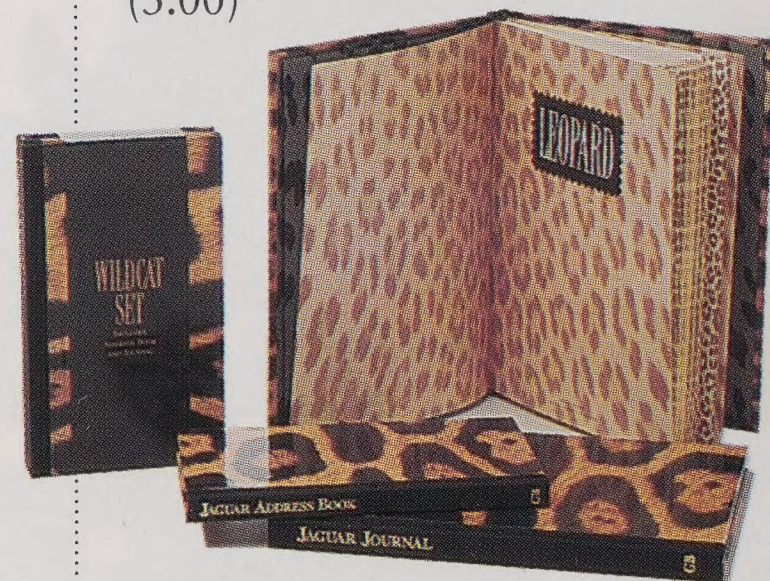
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